Chemical changes in basalts from IODP Site U1438: Subduction effects or alteration?

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IODP Expedition 351, Site U1438 was drilled in the Amami Sankaku Basin just west of the Kyushu-Palau Ridge, a remnant of the early Izu-Bonin-Mariana (IBM) arc, with the objective of understanding the basement on which the arc was constructed [1]. ^{40}Ar-^{39}Ar dating of these basalts did not yield ages older than arc initiation [2]. Instead, ages overlap with those of forearc basalts (FABs), the earliest products of IBM arc initiation, found in the IBM forearc [2] and drilled on IODP Expedition 352 [3]. Most Site U1438 basalts are also similar to FABs geochemically [4,5], except for the uppermost 12 meters. Here the basalts exhibit marked geochemical changes that continue upward to the basalt/sediment interface. These include higher MgO and SiO_2 contents, higher MgO/(MgO+ΣFeO), higher Na_2O/CaO, lower V and TiO_2 contents, and higher LILE (K, Rb, Ba, Sr), LREE, U and Th abundances compared with the lower subunits of the 150 meter basaltic section. Alternative explanations for the geochemical changes are: 1) that the upper subunit represents a different magma type, possibly transitional boninite, which would be expected in a subduction initiation sequence, or 2) that the chemical changes were produced by hydrothermal alteration of basalt and interaction with the overlying sediments subsequent to eruption. In this study, geochemical and petrologic arguments for and against these alternative explanations are presented. Most evidence suggests that hydrothermal alteration and exchange has affected the geochemistry of the rocks, but to date, a change in primary magma chemistry cannot be excluded.

[1] Arculus *et al.* (2015) *Nature Geoscience* **8**, 728-733. [2] Ishizuka *et al.* (2018) *EPSL* **481**, 80-90. [3] Reagan *et al*. (2017) *Int. Geol. Rev*. **59**, 1-12. [4] Hickey-Vargas *et al*. (2018) *Geochim. Cosmochim. Acta*. **229**, 85-111. [5] Yogodzinski *et al.* (2018) *Geochim. Cosmochim. Acta* **228**, 136-156.